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A NEW PLAN

FOR

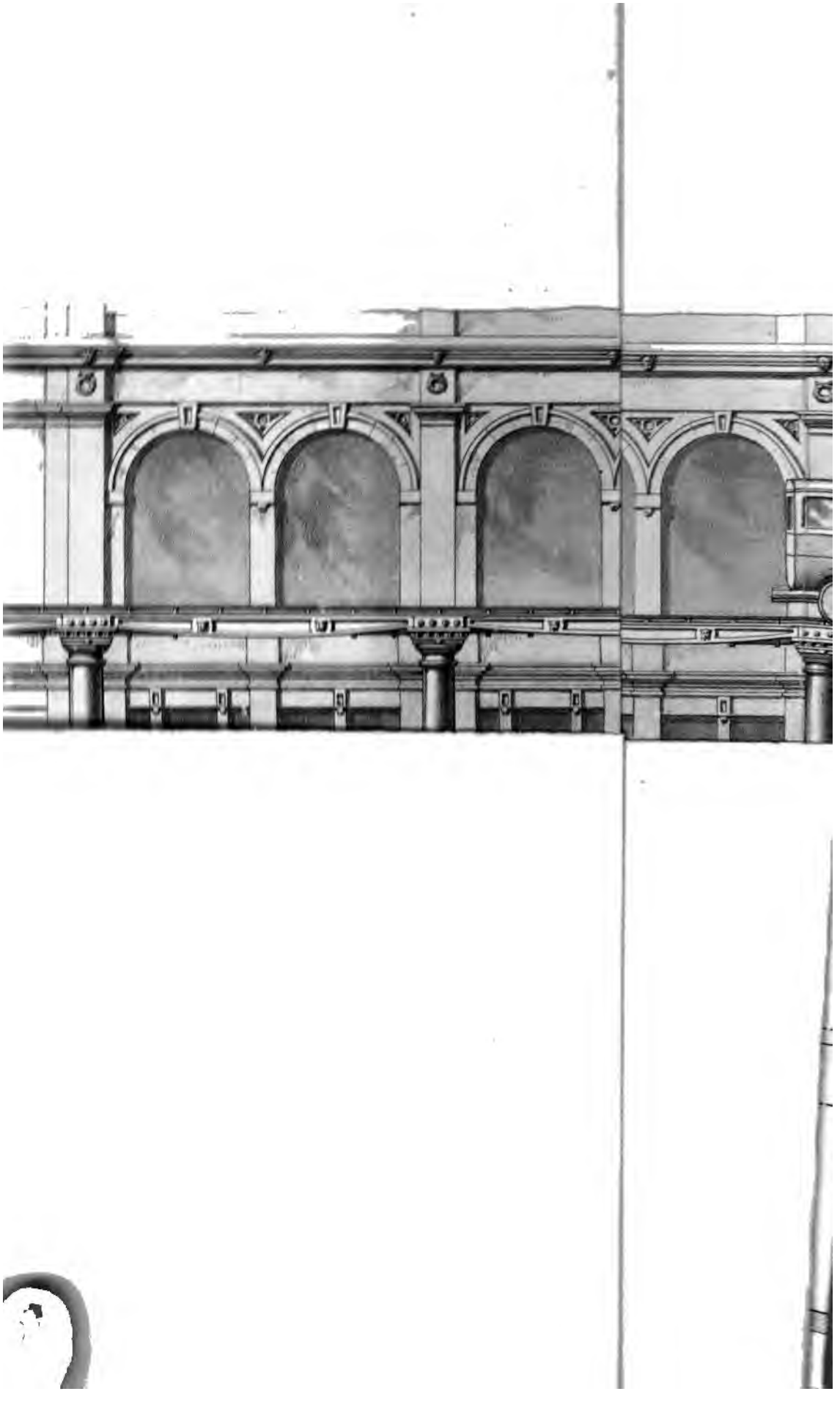
STREET RAILWAYS.

BY

T. W. RAMMELL, C.E.

LONDON:
EDWARD STANFORD, 6, CHARING CROSS.

1857.



STREET RAILWAYS.

Our railway system thus far is the triumph of our age and country; and we are justly proud of the enterprise and engineering skill which have covered Great Britain with its network of iron thoroughfares. Yet our greatest achievements of this kind have stopped short at a point which renders the attainment of their object incomplete. The traveller is carried through the country at increased speed and diminished cost, to be deposited at the outskirts of our great cities, and to reach his destination from this stage as slowly and expensively as ever. He may come from Brighton to London in little more than the time it will take him to come from the London Bridge Station to Paddington. The termini of our great lines, especially at the Metropolis, are disconnected by very wide intervals. A city, which is in fact a *province*, interposes between them; and while it remains a great gap in the continuity of their system, the capacities of this system for transit are undeveloped, and as regards its more central traffic, half its office is left undone.

The lines of communication between our provincial cities and our rural districts require to be completed at the centres to which they converge, for reasons which are obvious. But it is vastly more important, if less obvious, that a great metropolitan province, the population of which is the densest in the world, should partake the facilities enjoyed by the country. Increased speed and cheapness of transit within its boundaries are of more than ordinary consequence to its inhabitants, who perform the principal work of the nation, while for the most part living at a distance from their respective places of business. All classes whose time is of value, down to the operative who is driven by improvements to districts remote from his daily toil, and who inhabits suburban localities from necessity, as others

from fashion or inclination, or for health, have the very deepest interest in obtaining this provision. Consider the 10th, 8th, or 6th of the working hours consumed by the dilatory modes of transit we retain, and the difference to the Metropolitan community, though it cannot be computed, is immense. The work left undone may be cursorily estimated from the pleasure left unenjoyed under similar restrictions. On the outskirts of London there is a splendid palace, the most novel and probably the most attractive in the world, and it is so remote from those distant two or three miles from its railway terminus that it is rarely visited by Londoners so situated. The opportunities of great cities, on which we plume ourselves in an age of great cities, are thus abridged; and even their growth is thus practically limited.

Our own Capital has so far reached its limits, under the present system, that the current of traffic which is poured through its principal thoroughfares at its present rate of progress is continually choking them, so that acceleration, desirable generally, is here indispensable. The congested state of these thoroughfares is the source of incessant complaints, and of repeated experiments to add to their capacity by widening the old or by the construction of new channels; but as yet the traffic has increased faster than the accommodation, till its superabundance, with the necessity of providing for it more permanently, is admitted. It has been seriously proposed in consequence, that all the heavy traffic of the metropolis should pass through its streets after dark; in other words, that one half of its inhabitants should have the use of London by day, and the other half by night. For this arrangement there is the analogy of a popular farce; while, on the other hand, there is an equivalent also suggested, which does not entail similar or equal inconveniences. If the traffic of London could be passed through its streets at twice its present rate, the capacities of its present streets would be doubled. In proportion as the rate was increased, their capacity would be increased also, and increased speed would be a simple and elastic solution of the problem, but for a practical difficulty which imposes further conditions.

This difficulty is as follows. The railways which would afford the necessary increase of speed must run through, or in the close neighbourhood of, our present main thoroughfares. Railways of the ordinary kind could no doubt be constructed parallel to these; but at such a cost for construction, and at such a sacrifice of valuable property and space, that practically they are not to be regarded as a possible expedient. On the other hand, if railways could be laid down within the existing limits and on the present level of our streets, independently of other objections, they would abridge the already too narrow space and impede more traffic than they were able to accommodate. It follows, therefore, that no advantage whatever is attainable, unless the accelerated traffic is removed entirely from the present level of our streets; while, on the other hand, its removal would concurrently afford an immense increase of space and convenience, altogether irrespective of the rate of acceleration.

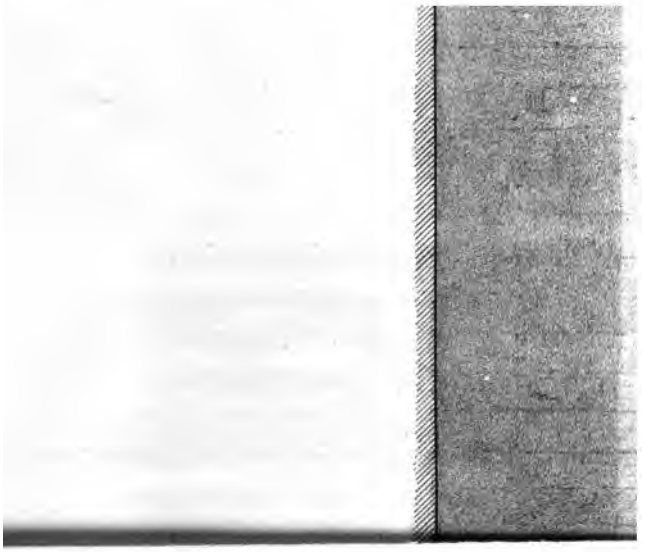
To remove the traffic in the line of the existing streets we must either carry it above or below them, since it is practically impossible to carry it in, or on either side of, them. It would certainly be possible, in fact it has been proposed, to carry it along subterraneous passages or tunnels; but here again the enormous expense and the difficulties of construction, independently of other considerations, interpose impediments. The engineering difficulties are all but insuperable; the existing sewers and the complicated series of gas and water pipes must be displaced or undermined; and if a system of underground railways were thus constructed, it is obvious that it would not serve to relieve the streets of their passenger traffic to any considerable extent. Men have not, like moles, a natural predilection for dark passages, but have an instinctive preference for light and air. Such tunnels would, however, be dark, damp, and noisome; and, if traversed by locomotives, would be continually filled with steam. Thus, if it is indispensable that any considerable portion of traffic shall be removed from the level of the streets, and must also be carried in the line of the streets, the railways for this purpose must pass *above* them at such a level as will admit the passage of other

traffic underneath. As this is the only alternative which presents itself, and to this it follows that we shall eventually come, the present plan has been devised with a view to this necessity, and with the object of meeting and removing all practical objections.

It should be premised, that the railways now proposed differ materially from any railways hitherto in use, being novel:—1st. In their form and method of construction; 2ndly. In the mode in which the propelling power—which is to be atmospheric—is to be applied; and 3rdly. In the plan of their course or route, and the arrangements for working their trains.

First, as to Form and Construction The adoption of the atmospheric principle of propulsion, and restriction of the traffic to passengers, with the use of iron as the material of construction, permit the lines to be of a lightness to which we have never approximated. The gauge will be considerably less than the present narrow gauge of the country lines, a standard width of 3 feet 9 inches having been fixed upon, instead of one of 4 feet 8½ inches. The way will be open between the rails, and there will be no parapet or outer work of any kind. It will in fact consist only of the two girder rails, with the atmospheric tube between them, the three members being firmly framed together, and supported at a height of 14 feet (or more, where the gradients require it) above the street surface by a single row of well proportioned cast-iron columns, placed generally along the line of the kerbstone of the foot pavements. The supporting columns will be secured to cylinders, also of cast-iron, sunk deep into the ground, and solidly embedded in concrete, and their union with the framework of the way will be effected by means of iron chair-pieces, resting as an architrave upon their capitals.

The carriages will be of the lightest possible description, and much nearer to the level of the rails than at present. They will be constructed with especial reference to the avoidance of noise; and in order that they may traverse curves of short radius the framework



of their wheels will be articulated. Each carriage will accommodate from 30 to 60 persons, according to the class to which it belongs.

The lines will be accessible at stations, either formed out of existing houses, or built expressly, but not projecting beyond the frontage plane of the street. Staircases, within the building, will lead to and from the waiting-rooms on the level of the first floor, which will be open to the platform.

A correct idea of the proposed construction, and of the arrangement of the stations, will be obtained by reference to the accompany drawings. No. 1 gives a general view of the line in plan and elevation. In No. 2, figs. 1, 2, and 3, the details of construction are shown; *a a*, are the supporting columns; *b* is the sunken cylinder; *c*, the chair piece, with seats to receive the girders, rails, *d d*, and the propulsion tube, *e*; *f f*, are framing pieces; an outline of a carriage upon the rails is shown at *g*; the station platform at *h*; and the stairs for ingress and egress at *i*. In figs. 4 and 5, supposed applications of the new railway to existing main thoroughfares are exhibited in transverse section.

Of this construction, it may be asserted:—

1. That it is simple in detail, and, as a whole, strong and compact.
2. That, the supporting parts consisting only of single columns, of small diameter, and with wide intercolumniations, it will practically occupy but little lateral space, and offer no impediment whatever to the freedom of communication between the main street and the foot pavements.
3. That it will obstruct neither light nor air.
4. That, presenting but little reverberating surface, it is well calculated for a noiseless transmission of traffic.
5. That it is not inelegant in appearance.
6. That it may be very readily erected or taken down, and with so much facility indeed that it might be properly

termed moveable. Thus the lines might be lengthened, shortened, diverted, or otherwise altered, as circumstances required.

7. That the process of its erection would not interfere with the existing street traffic.
8. That its cost would not be excessive.

Secondly, as to application of Propelling Power:—The Atmospheric principle can be here applied under conditions which, while they render it preferable to any oth seem to insure its complete efficiency. The frequent stations, and the quick succession of trains which the requirements of the traffic will demand, are obviously adapted to its peculiarities. But t e will be a wide difference between the proposed and any fo example of the application of the principle; so wide, indeed, definite comparison becomes necessary for its full appreciation. Thus, in regard to the four points of sectional length, continuity of working, weight of train, and speed, while in former examples the sections of tube to be exhausted from one end, have been in two, three, and four mile lengths, in the proposed example, each section to be so exhausted, will be under half a mile in length; while, heretofore, the working has been highly intermittent, a few minutes of consecutive action being followed by half-hour, hour, and even two hour intervals of cessation, under the proposed arrangements, the running of the trains will be nearly constant, the intervals of stoppage being less than a minute each, and the pumping will be continuous; and, as respects weight and speed, while hitherto it has been the practice to employ trains of 30, 50, and 70 tons weight each, propelled at a velocity of from 30 to 40 miles an hour, it is proposed to have light trains of 10, 15, or at most 20 tons each, to be moved at a speed of about 20 miles an hour. Independently, however, of these points of difference arising naturally out of altered circumstances, and of a contemplated improvement in the structure of the longitudinal valve to be presently described, the new example will present an important modification in the treatment of the atmospheric principle, consisting

in the introduction of a permanent working vacuum between the pumping engines of the system and the propulsion tube. This will be effected in the shape of a cast-iron pipe laid underground along the entire circuit of the line, and in connexion with a series of sunken chambers of size snfficient to afford the proper capacity of vacuum. The vacuum pipe will be everywhere closed, excepting at the end communicating with the pumping engines, and at the points of junction with the propulsion tube at the several stations, where the regulating valves will be established. Three great advantages will accrue from the adoption of a permanent vacuum: a reservoir of power always available, and which may be applied as instantaneously as steam to the cylinders of the locomotive engine, will be thus provided; the application of the power at and from the very platforms of the stations into which the trains are to be propelled, and with the utmost possible nicety of adjustment, will be permitted; while a freedom will be allowed to the action of the pumping engines, admitting of their action being extended over the short intervals of cessation in the running of the trains, so as to result in the great desideratum as regards their performance—*continuity*. It is conceived, that under the above arrangements, the exhaustion of air from the pipes of the atmospheric system may be carried as regularly, and with as much economy, as water is now lifted out of reservoir into main at any of the great water-works pumping establishments.

For the new longitudinal valve, it is proposed to discontinue the use of leather, and to substitute a material, the condition of which would alter less under variations of temperature; and also to modify the form of the valve, and that of its seating. The tight closure of the valve will not be effected imperfectly, as at present, by a profuse use of grease at surfaces barely contact, but rather by the compression of an elastic substance of which the edge of the valve will be formed against a smooth metal surface, placed in a nearly vertical position, the requisite pressure being given by a wheel running over the valve immediately behind the piston.

The above modifications, it is believed, will ensure absolute

certainty of action in the use of the atmospheric principle, with an economy of working hitherto unknown.

Thirdly, as to Plan of Route and Working Arrangements:—The proposed railways will pass through the present main thoroughfares of the Metropolis, but instead of being laid in the form of up and down lines from terminus to terminus, they will be so designed as to constitute, in each case, *an endless course*, round the entire circuit of which the trains will run, as a horse runs round the circuit of a racecourse. This provision for a continued movement or circulation of the trains in the same direction is an essential feature of the plan, and may be conveniently adapted in two ways to existing street arrangements. In some cases the endless lines of railway will be designed to pass up on one side of a line of streets, and down on the other side of the same streets, the circuit being completed by means of curved connexions at the two points most distant from each other. In other cases two endless lines of railway will run parallel to each other along one line of streets, where the streets themselves constitute a circuit; in other words, the lines will run along a succession of streets, say from north to south, and along other streets, continuing the course but reversing its direction from south to north, and the trains on the inner line will be constantly going in an opposite direction to those on the outer line, in each case the principle of an endless course being retained.

The lines being arranged on this principle, and stations provided at points equidistant, or nearly so, from one another, the traffic will be worked as in the following supposed example.

Let there be a line (say) six miles long in its entire circuit, with stations 660 yards (= $\frac{3}{8}$ths of a mile) apart, being sixteen stations in all, and with the electric telegraph laid round it. Let there be at every station a train of carriages, and at a given signal let every train be simultaneously set in motion in the same direction around the course, and let the motion be continued till the train which was at Station No. 1, has arrived at Station No. 2, and the train which was at Station No. 2 has arrived at Station No. 3, and so on with every train in

succession, including the train which was at Station No. 16, and which will be simultaneously moved on to Station No. 1, the next in advance of it. Let now sufficient time be allowed for the convenient setting down and taking up of passengers; and then, at another signal, let there be a second forward movement, to be followed by a like interval of rest and so for sixteen times successively, and it will be found that every train has got round to the station from which it originally started, having made the complete circuit of its course.

If, in this example, the distances between station and station were each travelled over in 1¼ minute, being at the average rate of eighteen miles per hour, and if the intervals of rest were three quarters of a minute each, every train completed the six mile circuit in thirty-two minutes, or at an average rate, including stoppages, of rather more than eleven miles an hour.

The considerations to be here taken into account are as follows:—

1. The immense public convenience which would be afforded by a line, with stations so close together and trains succeeding each other so rapidly, laid through the great thoroughfares, and in the very midst of the traffic.
2. The high average speed of the trains, (even with the moderate maximum, and including such frequent stoppages,) as compared with the ordinary rate of vehicles in the street.
3. The absence of danger from collision of train with train, since all the trains would be moving in the same direction around the course, and one could never overtake another.
4. The enormous carrying power of the line, and the large sum to which the aggregate returns would amount, at a very small fare, and of which a calculation is now suggested.

Take, as an elementary basis for an estimate, the hypothesis put above of a six-mile circuit, including sixteen stations. If at each

station ten passengers only on the average got into the train to be conveyed the distance desired, 160 passengers were received every two minutes, being at the rate of 4,800 per hour, or 76,800 per day of sixteen hours. If, on the average, each passenger paid 2*d.* for the journey, the passengers in the aggregate paid at the rate of £640 per diem, or £233,600 per annum.

But the returns to be expected are really much larger than this, though they depend upon elements too elastic for calculation. If, in the case of the Metropolis, we could guage the enormous current of passenger traffic which already pours through its main thoroughfares, in omnibuses, cabs, and other public conveyances, and if we assumed that by far the greater part of this traffic would be transferred to railways on the plan now proposed, even this extended estimate would fall short of the probable reality. The increased speed, cheapness, comfort, and convenience of the transit would, of themselves, develope traffic to an extent beyond all precedent, and which we seek in vain to calculate on any data we possess. The crowded steamboats of our one great Metropolitan highway, would be more than rivalled on a series of lines devised in more accommodating routes, available by more convenient approaches, and carrying passengers directly to their destination. Even the most productive of our present railways can suggest no approximation to the profits of lines which would carry passengers *only*, in numbers beyond all precedent or parallel. If the line from Manchester to Liverpool passed for its entire length through the most densely populated area in the world, and instead of two great termini at its two extremities, had a series of such termini at every 660 yards, we might, for example, make an inference from its then prosperity. But neither there, nor elsewhere, does a similar traffi exist; nor is it possible, elsewhere than within Metropolitan limits, to imagine the elements for an equal computation.

At the same time that an extraordinary benefit would be thus conferred on society, and which in the case of our own Metropolis, appears to be obtainable by no other agency, it does not appear that any objection which is fairly sustainable, can arise on the part of any

one to its immediate acceptance. The householders, in front of whose houses the trains would run, and who would be ordinarily shopkeepers, have the most plausible ground of complaint; yet even this will vanish on the briefest consideration. As neither light nor air would be obstructed by the proposed construction, and the passage of the trains would be all but noiseless, or would at least be less noisy than the traffic as at present conducted, the only objection the householders could raise, would be to the passage of the trains within a few yards of their first-floor windows. Assuming that this objection represented a real grievance, the small number of houses affected by it, in proportion to the aggregate house property of the Metropolis, would be a minor consideration, where the whole public is interested. But it may be fairly questioned, whether the householders would sustain any detriment, or rather whether they would not be greatly benefitted. The vast majority of them, as we said, are shopkeepers, who in these very thoroughfares are at present converting their first floors into showrooms and shops, and availing themselves of their frontage in the manner already adopted, to a greater degree on the Boulevards of Paris. This change would be accelerated by the establishment of the proposed lines, and by the general conversion of first floors into shops and show-rooms, the house would acquire two stories for display instead of one, and the householder, or houseowner, would be proportionally benefitted. To both of these stories a larger traffic of foot passengers would be attracted, by the facilities offered by the lines and their stations; and the shopkeeper would probably obtain a better market, while he certainly would participate in the general convenience. It would be doubtless easy, and it would also be desirable, to combine with the construction of these lines extended plans for street improvements, for these, unlike other railways through towns, would materially increase the value of every foot of property alongside of which they pass. But, even if a contrary result could be imagined, the question remains—Is there any alternative? Our streets are crowded to that intolerable excess, that the public vehicles must be moved out of them altogether, or in part; and no plan occurs by which so little

inconvenience is combined with so great and general an advantage. In this instance, nearly all the weights are in one scale, and all the considerations point to one conclusion.

Lastly, the very ground for a preliminary experiment is marked out by its local peculiarities, which do not admit even of these objections, and by the intervention there of the consideration first mentioned, that by this means we shall tend to complete the imperfect railway system of the country. A short circuit of a line, such as is proposed along the ample thoroughfare of the New Road, would connect the termini of the Great Western, London and North Western, and Great Northern Railways. This course might be easily extended to the city, so as to form part of a system uniting all the various termini in the city and on the southern side of the river; but the portion first mentioned might be constructed with the least difficulty. This portion would be a specimen and test of the entire system; it would benefit interests of the greatest magnitude, and it would demonstrate most easily, and on remunerative terms, that such facilities could as easily be extended to the rest of the community.

A Prospectus for this portion will shortly be issued, and in the meantime communications may be addressed to the Publisher.